

Project Number:

## PART 1--GENERAL

The Subcontractor shall furnish and install all equipment, materials, and supplies and perform all work and operations necessary for furnishing and installing the sanitary sewer piping and appurtenances complete as shown on the subcontract drawings and specified herein.

Furnish and install sanitary sewer piping, fixtures, and accessories as shown on the subcontract drawings and as specified herein.

## REFERENCES:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

**ASTM A194    Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service**

**ASTM D3350   Standard Specification for Polyethylene Plastics Pipe and Fittings Materials**

SANITARY SEWER PIPING 02722-1 of 5

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INTERNATIONAL ASSOCIATION OF PLUMBING & MECHANICAL OFFICIALS  
(IAPMO)

UPC                      Uniform Plumbing Code

SUBMITTALS:

Submittals include, but are not limited to the following:

TBD

Shop Drawings: Submit shop drawings to include the following:

Principal dimensions and details of construction.

Sizes and location of piping and components.

Product Data: Submit catalog data, specifications, and as-built drawings for each type of equipment furnished.

See Section 01300, Submittals and the Vendor Data Schedule for additional submittal requirements.

QUALITY CONTROL:

Codes and Standards: Comply with the requirements of the current revision of the following codes and standards, as specified in this specification:

UPC

PART 2--PRODUCTS

GENERAL:

All material, products, and equipment shall be manufactured as specified in this section or approved equals.

PIPE AND FITTINGS:

Polyethylene (NH) Piping and Fittings:

Service: Sanitary Waste (WQ)

Piping: Piping shall be 100 psi minimum, seamless VHMWHD polyethylene Driscopipe No. 8600, as manufactured by Phillips, or approved equal, UL Listed, per ASTM D 1248 and D 3350.

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Fittings: Fittings shall be 100 psi minimum, VHMWHD polyethylene Driscopipe No. 8600, ends suitable for butt-fusion, as manufactured by Phillips, or approved equal, UL Listed, per ASTM D 1248 and D 3350.

Flanges: Flanges shall be slip-on (flat metal plate) 304 SST, 150 psi Driscopipe or approved equal in accordance with ANSI B16.21.

Bolts: Bolts shall be SST, ASTM A 193, Grade B8, and Galling Resistant Nitronic 60 nuts, ASTM A 194, Grade 8S (UNS S21800).

#### FIXTURES, FITTINGS AND TRIM:

Products shall be of the manufacturers listed below, or approved equal:

Cleanouts: Cleanouts shall be Model 6000 cast iron cleanout with gasket hub outlet and cast iron plug as manufactured by Tyler Pipe, or approved equal.

Silicone Sealant: If sewer pipe penetrates a fire barrier sealant shall be Hilti Ciba-Geigy Firestop Sealant, or approved equal.

Identification Ribbon (GFE): Identification ribbon shall be 3-in. minimum wide, with a message printed on the ribbon that identifies the actual pipeline contents.

The plastic ribbon shall be color coded in conformance with the following:

<u>Pipeline Contents</u>	<u>Tape Color</u>	<u>Lettering Color</u>
Sanitary Waste	Brown	White

Locator Ribbon: See Section 02200, Earthwork.

#### PART 3--EXECUTION

##### PIPELINES:

Pipe shall be bedded in sand, insulation or other approved material, 4-in. minimum in all directions.

Install pipe to uniform pitches between points for which elevations are established. Provide bends or elbows for changes in directions. One-quarter bends shall be long sweep type.

Between bends or elbows, lines shall be straight, free from irregularities, and have smooth interior surfaces. Reducers shall be required for changes in the size of pipes and fittings.

Bushings shall not be used.

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Potable water lines include only potable water (CW). Utility lines includes fire water (FW), raw water (RW). Process lines shall include all other process, waste, sanitary, and service lines.

Potable water lines shall be separated from other lines horizontally and vertically as specified below:

Potable water shall be separated from utility lines by a minimum of 12 in. horizontally (outside wall to wall), and a minimum of 12 in. above vertically (top of utility pipe to bottom of potable water pipe).

Potable water lines shall be separated from process lines by a minimum of 10 ft. horizontally, or; separated by 6 ft. horizontally and 18 in. vertically and the process line shall be constructed, as a minimum, to the requirements of the water line, or encased in 4" minimum of concrete all around, or double encased in welded Sch. 40 CS or polyethylene pipe sealed at both ends.

FIELD QUALITY CONTROL:

Surveillance will be performed by Contractor's Representative to verify compliance of the work to the drawings and specifications.

### CLEANSING AND TESTING:

All piping systems shall be cleaned and tested as specified in Section 15490 of this specification, and shall be witnessed by the Contractor's Representative.

END OF SECTION 02722

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SECTION 03300--CAST IN PLACE CONCRETE

PART 1--GENERAL

SUMMARY:

Section Includes: Work includes, but is not limited to:

Exterior sidewalks and stoops  
Footings, foundations, retaining walls  
Slabs and floors  
Electrical duct banks  
Thrust blocks for underground pipelines  
Concrete reinforcement and associated items  
Guardpost fill  
Storage, equipment and truck scale pads

REFERENCES:

The following documents, including others referenced therein, form part of this Section to the extent designated herein:

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	Standard Specifications for Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete for Buildings
ACI 305	Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 347	Guide to Formwork for Concrete

CONCRETE REINFORCING STEEL INSTITUTE, (CRSI)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 94	Standard Specification for Ready-Mixed Concrete
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The following ASTM specifications are referenced in regard to materials:

ASTM A 185	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615	Standard Specification for Deformed and Plain Billet-Steel Bar for Concrete Reinforcement
ASTM C 33	Standard Specification for Concrete Aggregates

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1       ASTM C 150   Standard Specification for Portland Cement  
2       ASTM C 260   Standard Specification for Air-Entraining Admixtures for Concrete  
3       ASTM C 309   Standard Specification for Liquid Membrane-Forming Compounds for  
4                    Curing Concrete  
5       ASTM C 494   Standard Specification for Chemical Admixtures for Concrete  
6       ASTM C 618   Standard Specification for Coal Fly Ash and Raw or Calcined Natural  
7                    Pozzolan for Use as a Mineral Admixture in Concrete  
8

9       The following ASTM standards shall be used by the inspecting agency for concrete  
10                    tests or inspections:

11  
12       ASTM C 31   Standard Practice for Making and Curing Concrete Test Specimens in  
13                    the Field  
14       ASTM C 39   Standard Test Method for Compressive Strength of Cylindrical  
15                    Concrete Specimens  
16       ASTM C 143   Standard Test Method for Slump of Hydraulic Cement Concrete  
17       ASTM C 172   Standard Practice for Sampling Freshly Mixed Concrete  
18       ASTM C 231   Standard Test Method for Air Content of Freshly Mixed Concrete by  
19                    the Pressure Method  
20

## 21   SUBMITTALS:

22  
23   Submittals include, but are not limited to the following:

24  
25   Concrete Placements: Submit a list of concrete placements for which air entrainments is not  
26   required.  
27

28   Mix Design: Submit mix design for each grade of concrete used.  
29

30   Batch Tickets: Supply a copy of the batch ticket with each load of concrete.  
31

32   See Section 01300, Submittals and the Vendor Data Schedule for additional submittal  
33   requirements.  
34

## 35   QUALITY CONTROL:

36  
37   Comply with provisions of ACI 301 unless otherwise specified herein.  
38

## 39   PART 2--PRODUCTS

### 40 41   FORM MATERIALS:

42  
43   Forms for Exposed Finish Concrete: Provide continuous, straight, smooth, exposed surfaces.  
44   Furnish in largest practicable sizes to minimize number of joints. Provide form material with

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sufficient thickness to withstand pressure of newly-placed concrete without visible bow or deflection.

Plywood shall comply with American Plywood Association, grade "EXT-DFPA PLYFORM" or better.

Where extra degree of smoothness is required, plywood shall comply with U.S. Product Standard PS-1 "B-B High Density Overlaid Concrete Form," Class I.

Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, or metal.

**Form Coatings:** Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

### REINFORCING MATERIALS:

**Reinforcing Bars:** ASTM A 615 Grade 60 deformed, as indicated on the drawings. Grade 40 may be used for No. 4 and smaller ties.

**Welded Wire Fabric (WWF):** ASTM A 185, welded steel wire fabric.

**Supports for Reinforcement:** Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing in place. Use wire bar type supports complying with CRSI recommendations, or approved substitute. Use supports with sand plates or horizontal runners where base material will not support chair legs. Pumice blocks, adobe, bricks, rocks, etc. are not acceptable for rebar or wire mesh supports.

## CONCRETE MATERIALS:

**Portland Cement:** Cement shall conform to ASTM C 150, Type I-II (Type III may be used for prestressed concrete). The cement shall contain no more than 0.60% by weight of alkalis calculated as  $(\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O})$ .

**Aggregate:** Fine and coarse aggregate shall conform to ASTM C 33. Maximum coarse aggregate size shall conform to ACI 318 paragraph 3.3.2. Unless otherwise specified, maximum aggregate size shall be 1 1/2 in.

Mixing Water: Potable having no pronounced taste or odor, and containing no deleterious materials.

**Air-Entraining Agents (AEA): ASTM C 260.**



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1    High Range Water-Reducing Admixture (Superplasticizer): If a superplasticizer is used it  
2    shall conform to ASTM C 494, Type F.

3  
4    Water-Reducing Admixtures: If water-reducing admixtures are used they shall conform to  
5    ASTM C 494, Type A, and contain no more than 1 % chloride ions.

6  
7    Calcium Chloride: Calcium chloride is not permitted.

8  
9    Pozzolans: Pozzolans (fly ash) shall conform to ASTM C 618 Class F, except that the loss  
10   on ignition (LOI) shall be less than 2%.

11  
12   RELATED MATERIALS:

13  
14   Waterstops: Provide dumbbell type waterstops at all construction or other type joints when  
15   called for on the drawings.

16  
17        Rubber Waterstops: Corps of Engineers CRD-C513.

18        Polyvinyl Chloride (PVC) Waterstops: Corps of Engineers CRD-C572.

19  
20   Nonshrink Grout: Provide one of the following or approved equal:

21  
22        "Masterflow 713;" Master Builders

23        "SonogROUT;" Sonneborn Building Products

24        "Five Star Grout;" U.S. Grout Co.

25  
26   Curing Compound: Curing compound or curing-hardener-sealer compound shall comply  
27   with ASTM C 309, Type I, Class A.

28  
29   The compound shall be compatible with adhesives or paints if it is to be applied in areas to  
30   receive paint or floor covering requiring adhesives. Areas of concrete to receive mortar set  
31   tile shall not be cured by a curing compound. The number of coats shall be as recommended  
32   by the manufacturer, but in any case, floor slabs to be left exposed shall receive at least a  
33   second coat just after final clean-up.

34  
35   Bonding Compound: Provide one of the following, or approved equal:

36  
37        "Everbond" L & M Construction Chemical Corporation

38        "Sikabond" Sika Corporation

39        "Sonocrete" Sonneborn Building Products

40        "Weld-Crete" Larsen Products Corporation.

41  
42   Joint-Sealing Compound: Provide a polyurethane joint sealant material.

43  
44   Expansion Joint Material: Provide 1/2 in. asphalt impregnated fibrous expansion material.

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Red Coloring for Electrical Duct Encasement: Commercial grade red iron oxide, 3 lb per sack of cement.

## PROPORTIONING AND DESIGN OF MIXES:

**Mix Design:** Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 318.

Design mixes to provide normal weight concrete with the following specified 28-day compressive strengths, minimum, as indicated on drawings and schedules:

**Class 20: 2000 psi (conduit encasement)**

**Class 30: 3000 psi (guardpost fill, thrustblocks)**

Class 40: 4000 psi (structural concrete)

**Class 45: 4500 psi (exterior sidewalks, pads and retaining walls)**

See FIELD QUALITY CONTROL of this specification for acceptance criteria.

Adjustment to concrete mixes may be requested by the Subcontractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Revised mix designs must be submitted and approved prior to use.

The concrete mix shall contain a pozzolan (fly ash) unless otherwise approved by the Contractor's Representative.

Concrete in hard-to-place locations may utilize a high-range water reducer. No other water-reducer shall be used with a high-range water-reducer.

**Durability:** Concrete which will be subject to freezing and thawing, weathering, or deicer chemicals shall be air-entrained. Add air entraining agent (AEA) at the manufacturer's prescribed rate to result in concrete at point of placement having air content within the following limits:

Maximum aggregate size (in.)	Air content (percent)	
	Severe exposure	Moderate exposure
1/2	5 1/2 to 8 1/2	4 to 7
3/4	4 1/2 to 7 1/2	3 1/2 to 6 1/2
1	4 1/2 to 7 1/2	3 to 6
1 1/2	4 to 7	3 to 6

The Subcontractor shall submit a list of all concrete placements for which air entrainment is not required for review and approval.

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Concrete which will be subject to deicer chemicals or freezing and thawing in a moist condition shall have a minimum 28 days compressive strength of 4,500 psi and a maximum water-cementitious materials ratio of 0.45.

Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

Reinforced foundations:  $3 \pm 1$  in.

Slabs, pads and other structural concrete:  $3 \frac{1}{2} \pm 1 \frac{1}{2}$  in.

Red concrete for conduit encasement: Not less than 3 in. and not more than 6 in.

Maximum slump for concrete using a high-range water-reducer may be increased to 8 in. at point of placement.

#### MIXING AND DELIVERY:

The manufacture and delivery of all concrete shall conform to ASTM C 94 except as modified herein. Hand-mixed concrete is prohibited.

When concrete arrives at the job site with slump below that suitable for placing, as indicated by the specification, water may be added only if the maximum permissible water-cement ratio and the maximum permissible slump is not exceeded. Any water thus added to bring the slump within required limits shall be injected in such a manner that uniformity requirements are met. Water shall be incorporated by additional mixing equal to at least half of the total mixing required or 30 drum revolutions at rated mixing speed, whichever is more. Additional AEA may be introduced during this mixing period if necessary to meet specifications. Neither water nor AEA shall be added to the batch at any later time.

Concrete uniformity shall meet the requirements of ASTM C 94 except as modified herein. After final mixing is complete, visible lumps, nonconformance to uniformity requirements, or failure to meet specified slump, entrained air and temperature requirements shall be considered cause for rejecting the remainder of the load. In addition, failure of the ready-mix truck drum to meet uniformity requirements will be deemed cause for rejection of the mixing equipment until adequate repairs have been made.

Discharge of the concrete shall be completed within  $1 \frac{1}{2}$  hrs, or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of mixing water to the cement and aggregates. This  $1 \frac{1}{2}$  hr limit may be extended by the Contractor if the concrete still meets all specified requirements after  $1 \frac{1}{2}$  hrs. (Additional testing to verify conformance to specifications may be necessary.) In hot weather or under conditions contributing to quick stiffening of the concrete a time limit less than  $1 \frac{1}{2}$  hrs may be designated by the Contractor.

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The concrete mix shall contain a pozzolan (fly ash) unless otherwise approved by the Contractor's Representative.

Concrete in hard-to-place locations may utilize a high-range water-reducer. No other water-reducer shall be used with a high-range water-reducer.

Durability: Concrete which will be subject to freezing and thawing, weathering, or deicer chemicals shall be air-entrained. Add air entraining agent (AEA) at the manufacturer's prescribed rate to result in concrete at point of placement having air content within the following limits:

Maximum aggregate size (in.)	Air Content (percent)	
	Severe exposure	Moderate exposure
1/2	5 1/2 to 8 1/2	4 to 7
3/4	4 1/2 to 7 1/2	3 1/2 to 6 1/2
1	4 1/2 to 7 1/2	3 to 6
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2 condition shall have a minimum 28 days compressive strength of 4,500 psi and a maximum  
3 water-cementitious materials ratio of 0.45.

4  
5 Slump Limits: Proportion and design mixes to result in concrete slump at point of placement  
6 as follows:

7  
8       Reinforced foundations:  $3 \pm 1$  in.

9  
10       Slabs, pads and other structural concrete:  $3 \frac{1}{2} \pm 1 \frac{1}{2}$  in.

11  
12       Red concrete for conduit encasement: Not less than 3 in. and not more than 6 in.

13  
14       Maximum slump for concrete using a high-range water-reducer may be increased to 8  
15 in. at point of placement.

16  
17 MIXING AND DELIVERY:

18  
19 The manufacture and delivery of all concrete shall conform to ASTM C 94 except as  
20 modified herein. Hand-mixed concrete is prohibited.

21  
22 When concrete arrives at the job site with slump below that suitable for placing, as indicated  
23 by the specification, water may be added only if the maximum permissible water-cement  
24 ratio and the maximum permissible slump is not exceeded. Any water thus added to bring  
25 the slump within required limits shall be injected in such a manner that uniformity  
26 requirements are met. Water shall be incorporated by additional mixing equal to at least half  
27 of the total mixing required or 30 drum revolutions at rated mixing speed, whichever is more.  
28 Additional AEA may be introduced during this mixing period if necessary to meet  
29 specifications. Neither water nor AEA shall be added to the batch at any later time.

30  
31 Concrete uniformity shall meet the requirements of ASTM C 94 except as modified herein.  
32 After final mixing is complete, visible lumps, nonconformance to uniformity requirements, or  
33 failure to meet specified slump, entrained air and temperature requirements shall be  
34 considered cause for rejecting the remainder of the load. In addition, failure of the ready-mix  
35 truck drum to meet uniformity requirements will be deemed cause for rejection of the mixing  
36 equipment until adequate repairs have been made.

37  
38 Discharge of the concrete shall be completed within  $1 \frac{1}{2}$  hrs, or before the drum has  
39 revolved 300 revolutions, whichever comes first, after the introduction of mixing water to the  
40 cement and aggregates. This  $1 \frac{1}{2}$  hr limit may be extended by the Contractor if the concrete  
41 still meets all specified requirements after  $1 \frac{1}{2}$  hrs. (Additional testing to verify  
42 conformance to specifications may be necessary.) In hot weather or under conditions  
43 contributing to quick stiffening of the concrete a time limit less than  $1 \frac{1}{2}$  hrs may be  
44 designated by the Contractor.

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1 High-range water-reducing admixtures (superplasticizer) shall be added to the mixer at the  
2 job site, and then be allowed to mix for at least 5 min.

3  
4 Concrete which is rejected for failure to meet any of the above  
5 requirements will be evaluated by the Contractor and may be removed and replaced at the  
6 expense of the Subcontractor.

7  
8 Hot or Cold Weather Concreting: Methods and means of batching, mixing and delivery of  
9 concrete in hot or cold weather shall comply with ACI-301 or ACI-306.1

10  
11 SOURCE QUALITY CONTROL:

12  
13 The Subcontractor shall provide the necessary testing and monitoring to qualify proposed  
14 materials and establish mix designs.

15  
16 PART 3--EXECUTION

17  
18 FORMS:

19  
20 Unless otherwise shown on the drawings, all forms shall be straight and plumb, rigid and  
21 mortar tight. All forms shall be braced, tied and supported sufficiently to maintain their  
22 required position during and after the placing of concrete. Joints shall be sufficiently tight to  
23 prevent mortar leakage. Where shown on the drawings, suitable moldings shall be placed in  
24 forms to shape edges or surfaces of concrete members. All formwork shall conform to the  
25 guidelines in ACI 347.

26  
27 All exposed corners of concrete shall be chamfered 1 in.

28  
29 Form Ties: Use factory-fabricated, adjustable-length, removable or snapoff metal form ties,  
30 designed to prevent form deflection, and to prevent spalling concrete surface upon removal:

31  
32 Unless otherwise indicated, provide ties so that portions remaining within concrete after  
33 removal will not be within 1 in. of any exposed concrete surface.

34  
35 Form ties for walls subject to hydrostatic pressure shall have water seals.

36  
37 Provisions for Other Trades: Provide openings in concrete formwork to accommodate work  
38 of other trades.

39  
40 Tolerances: Unless otherwise noted on the drawings, formwork shall be constructed so that  
41 the concrete surfaces conform to the tolerance limits listed in ACI 117.

42  
43 Preparation of Form Surfaces: Coat contact surfaces of forms with a form-coating compound  
44 before reinforcement is placed. Do not allow form-coating compound to come into contact  
45 with reinforcement or with concrete surfaces against which fresh concrete will be placed.

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1  
2 **PLACING REINFORCEMENT:**  
3

4 Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or  
5 destroy bond with concrete.  
6

7 Accurately position, support and secure reinforcement against displacement by formwork,  
8 construction, or concrete placement operations.  
9

10 Place reinforcement to obtain at least minimum coverages for concrete protection. Unless  
11 otherwise indicated, reinforcement position shall be as necessary to meet coverage, spacing  
12 and placement requirements specified in ACI 318, Chapter 7.  
13

14 Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one  
15 full grid plus 2 in. and lace splices with wire of same gage. Fabric shall be supported on  
16 metal chairs placed on 8 in. x 8 in. x 22 gage sheet metal base plates and spaced to meet  
17 placement tolerance requirements of ACI 318, Chapter 7.  
18

19 Unless otherwise shown on the drawings, splicing of reinforcement shall be in accordance  
20 with ACI 318, Chapters 7 and 12. Unless otherwise indicated on the drawings, all splices  
21 shall be Class B tension splices for regular bars.  
22

23 **JOINTS:**  
24

25 **Construction Joints:** Locate and install construction joints, when not shown on drawings, so  
26 as not to impair strength and appearance of the structure, and as acceptable to the Contractor's  
27 Representative.  
28

29 Provide keyways at least 1 1/2 in. deep in all construction joints unless otherwise noted.  
30

31 Provide waterstops in construction joints as indicated.  
32

33 **Isolation (Expansion) Joints in Slabs-on-Ground:** Construct isolation joints in slabs-on-  
34 ground at points of contact between slabs on ground and vertical surfaces, such as column  
35 pedestals, foundations walls, and as indicated on the drawings. Provide expansion joint  
36 material in all isolation joints. Material shall be placed 1/4 in. below slab elevation and  
37 extend the full depth of the slab.  
38

39 **Control Joints (Contraction) in Slabs-on-Ground:** Construct control joints as shown on the  
40 drawings. Joints shall be sealed with a polyurethane sealant material per manufacturer's  
41 recommendation. Saw cutting shall conform to ACI 301, Section 11.5.

42 **Asphalt and Slabs-On-Ground Interface:** Sawcut existing asphalt where concrete and asphalt  
43 are to meet in order to provide a straight, clean joint.  
44

45 **INSTALLATION OF EMBEDDED ITEMS:**

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1  
2 Set and build into work anchorage devices and other embedded items required for other work  
3 that is attached to, or supported by cast-in-place concrete. Secure all such items firmly in  
4 position.

5  
6 **CONCRETE PLACEMENT:**

7  
8 **Preplacement Inspection:** Completed formwork, reinforcing steel, and items to be embedded  
9 shall be inspected and approved prior to placement. However, such approval shall in no way  
10 release the Subcontractor from responsibility for acceptable and satisfactorily completed  
11 work. For concrete cast against soil, the soil shall be free from frost or ice and shall be  
12 wetted down before placement.

13  
14 **Placing Concrete in Forms:** The concrete shall be deposited continuously in horizontal layers  
15 not more than 2 ft in depth with each succeeding layer placed before the preceding layer has  
16 reached its initial set.

17  
18 **Consolidation:** During and immediately after placing, all concrete shall be consolidated  
19 sufficiently to provide thorough placement around all reinforcement, embedded items, and  
20 into corners of forms without segregating the mix. Vibration shall penetrate the placed layer  
21 and at least 6-in. into the preceding layer. Do not use vibrators to move concrete inside the  
22 forms. A spare vibrator shall be on hand at the job site and available to substitute for any  
23 other vibrator which fails during placement.

24  
25 **Dropping of Concrete:** Maximum allowable free vertical drop shall be 5 ft, but dropping of  
26 concrete from this height through reinforcement (as in columns and walls), or other  
27 conditions causing segregation, shall be avoided. For drops greater than 5 ft, a confining  
28 device shall be used, subject to the approval of the Contractor.

29  
30 **Cold Weather Placing:** Protect concrete work from damage or reduced strength which could  
31 be caused by frost, freezing, or low temperatures, in compliance with ACI 306 and as  
32 specified herein. Minimum concrete temperature as placed and maintained shall be 55° F, or  
33 as required by ACI-306, Table 3.1, line 1.

34  
35 **Hot Weather Placing:** When hot weather conditions that would seriously impair quality and  
36 strength of concrete exist, place concrete in compliance with ACI 305 and as specified  
37 herein: Cool mixing drum and/or ingredients before mixing to maintain concrete temperature  
38 below 95° F at time of placement.

39  
40  
41 **FINISH OF FORMED SURFACES:**

42  
43 **Rough Form Finish (RfFm):** Provide as-cast rough form finish to formed concrete surfaces  
44 that are to be concealed in finish work or by other construction, unless otherwise indicated.  
45



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1 Standard rough form finish shall be the concrete surface having the texture imparted by the  
2 form facing material used, with tie holes and defective areas repaired and patched and all fins  
3 and other projections exceeding 1/4 in. in height rubbed down or chipped off.

4  
5 Smooth Form Finish (SmFm): Provide as-cast smooth form finish for formed concrete  
6 surfaces that are exposed-to-view, or that are covered with a coating material applied directly  
7 to concrete, or a covering material bonded to concrete such as waterproofing, dampproofing,  
8 painting, or other similar system.

9  
10 Produce smooth form finish (SmFm) by selecting form material to impart a smooth, hard,  
11 uniform texture and arranging them orderly and symmetrically with a minimum of seams.  
12 Repair and patch defective areas with fins or other projections completely removed and  
13 smoothed.

14  
15 Smooth Rubbed Finish (SmRbd): Provide smooth rubbed finish to scheduled concrete  
16 surfaces which have received smooth form finish treatment, not later than one (1) day after  
17 form removal.

18  
19 Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform  
20 color and texture is produced. Do not apply cement grout other than that created by rubbing  
21 process.

22  
23 Grout Cleaned Finish (GrtCl): Provide grout cleaned finish to scheduled concrete surfaces,  
24 which have received smooth form finish treatment.

25  
26 Combine one part Portland cement to 1 1/2 parts fine sand by volume, and mix with water to  
27 consistency of thick paint. Blend standard Portland cement and white Portland cement,  
28 amounts determined by trial patches, so that final color of dry grout will closely match  
29 adjacent concrete surfaces. Thoroughly wet concrete surface and apply grout uniformly by  
30 brushing or spraying immediately to wetted surfaces. Scrub surface with cork float or stone  
31 to coat surface and fill surface holes. Remove excess grout by scraping, followed by rubbing  
32 with clean burlap to remove visible grout film. Keep grout damp during setting period by  
33 means of fog spray at least 36 hrs after final rubbing. Complete any area in same day it is  
34 started, with limits of area being natural breaks in finished surface.

35  
36 Related Unformed Surfaces: At tops of wall, horizontal offsets, and similar unformed  
37 surfaces occurring adjacent to formed surfaces, strike off smooth and finish with texture  
38 matching adjacent formed surfaces.

39  
40 SLAB FINISHES:

41  
42 Scratch Finish (Scr): Apply scratch finish to monolithic slab surfaces to receive concrete  
43 floor topping, and as otherwise shown on drawings.

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1   After placing slabs, plane surface to a tolerance not exceeding 1/2 in. in 10 ft when tested  
2   with a 10-ft straightedge. Slope surfaces uniformly to drains where required. After leveling,  
3   roughen surface before final set with stiff brushes, brooms or rakes.

4  
5   Float Finish (Flt): Apply float finish to monolithic slab surfaces to receive trowel finish and  
6   other finishes as hereinafter specified, and slab surfaces which are to be covered with  
7   membrane or elastic waterproofing, membrane or elastic roofing, and as otherwise shown on  
8   drawings or in schedules.

9  
10   After screeding, consolidating, and leveling concrete slabs, do not work surface until ready  
11   for floating. Begin floating when surface water has disappeared or when concrete has  
12   stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface  
13   with power driven floats, or by hand-floating if area is small or inaccessible to power units.  
14   Check and level surface plane to a tolerance not exceeding 1/4 in. in 10 ft when tested with a  
15   10-ft straightedge placed on surface at not less than two different angles. Cut down high  
16   spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling,  
17   refloat surface to uniform, smooth, granular texture.

18  
19   Trowel Finish (Trw): Apply trowel finish to monolithic slab surfaces to be exposed to view,  
20   unless otherwise indicated, and slab surfaces to be covered with paint, or other thin-film  
21   finish coating system.

22  
23   After floating, begin first trowel finish operation using power-driven trowel. Begin final  
24   troweling when surface produces ringing sound as trowel is moved over surface.

25  
26   Consolidate concrete surface by final hand troweling operation, free of trowel marks, uniform  
27   in texture and appearance, and with surface plane tolerance not exceeding 1/8 in. in 10 ft  
28   when tested with a 10-ft straightedge.

29  
30   Nonslip Broom Finish (Brm): Apply nonslip broom finish to exterior concrete platforms,  
31   steps, and ramps, and elsewhere as shown on drawings or in schedules.

32  
33   Immediately after float finishing, slightly roughen concrete surface by brooming in direction  
34   perpendicular to main traffic route.

#### 35 36 37 38 39 40   CONCRETE CURING AND PROTECTION:

41  
42   General: Protect freshly placed concrete from injurious action by sun, rain, wind, flowing  
43   water, mechanical injury and premature drying for not less than seven (7) consecutive days  
44   after placement.

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1 Protect concrete against damage from frost or freezing for a minimum of 3 days. Provisions  
2 of ACI 306.1 shall apply for cold weather unless otherwise specified.

3  
4 Alternatively, if tests are made of cylinders kept near the structure and cured by the same  
5 methods, moisture retention measures may end when the average compression strength has  
6 reached 70% of the specified strength. Other alternatives such as those given in ACI 301,  
7 12.2.3 may also be used if approved by the Contractor.

8  
9 Early Loading of New Concrete: Early loading of concrete structures shall comply with  
10 requirements of ACI 318, Section 6.2. When construction loading is proposed before  
11 concrete has achieved its 28-day design strength, structural calculations and concrete strength  
12 test data shall be submitted and approved prior to loading.

13  
14 Curing Methods: Perform curing of concrete by one or more of the following methods:

15  
16 Moist Curing: Cover concrete surfaces with moisture-retaining cover for curing period.  
17 Exposed horizontal concrete surfaces may be covered with sand or other approved material  
18 and kept wet for the required period. Wood forms shall be kept sufficiently wet at all times  
19 to prevent the forms from separating at the joints and the concrete from drying.

20  
21 Membrane Curing: Concrete surfaces to receive membrane curing shall be treated with a  
22 curing compound as specified or otherwise approved. The curing compound shall be applied  
23 in strict accordance with the directions of the manufacturer of the compound.

24  
25 Temperature, Wind, and Humidity:

26  
27 Cold weather: When the mean daily outdoor temperature is less than 40° F, the temperature  
28 of the concrete surface shall be maintained between 55 and 90° F for the required curing  
29 period. When necessary, arrangements for heating, covering, insulating, or housing the  
30 concrete work shall be made in advance of placement and shall be adequate to maintain the  
31 required temperature without injury due to concentration of heat. Combustion heaters shall  
32 not be used during the first 24 hrs unless precautions are taken to prevent exposure of the  
33 concrete to exhaust gases that contain carbon dioxide. If early loading is anticipated during  
34 cold weather, provide temperature protection to insure necessary strength development.

35  
36 The concrete surface temperature requirements (based on section thickness) in ACI 306.1  
37 may be used in lieu of the 55° F minimum specified before.

38  
39 If concrete surface temperatures as measured by the inspecting agency are below the  
40 minimum curing temperature but meet the freeze protection requirements, the concrete curing  
41 period shall be extended to ensure adequate strength is developed. The extension time shall  
42 be at least equivalent to the time period in which temperatures were too low.

43  
44 Hot weather: The concrete surfaces shall be kept below 100° F for the curing period. When  
45 necessary, provision for windbreaks, shading, fog spraying, sprinkling, ponding, or wet

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1 covering with a light colored material shall be made in advance of placement, and such  
2 protective measures shall be taken as quickly as concrete hardening and finishing operations  
3 will allow.

4  
5 Rate of temperature change: Changes in temperature of the air immediately adjacent to the  
6 concrete during and immediately following the curing period shall be kept as uniform as  
7 possible and shall not exceed 5° F in any 1-hr or 50° F in any 24-hr period.

8  
9 REMOVAL OF FORMS:

10  
11 Formwork Not Supporting Weight of Concrete: This formwork may be removed after  
12 cumulatively curing at not less than 50° F for 32 hrs after placing concrete, provided concrete  
13 is sufficiently hard not to be damaged by form removal or subsequent operations. Curing  
14 must then continue through the minimum curing period.

15  
16 Formwork Supporting Weight of Concrete: This formwork may not be removed until  
17 concrete has attained its 28-day design compressive strength, except as permitted under  
18 "Early Loading of New Concrete".

19  
20 CONCRETE SURFACE REPAIRS:

21  
22 All porous and fractured concrete shall be repaired. Surface defects may be repaired by  
23 patching. Surface defects include color and texture irregularities, cracks, spalls, air bubbles,  
24 honeycomb, rock pockets, fins, snap-tie holes and other projections on the surface. All  
25 repairs shall be approved by the Contractor. Alternate repair methods not specified may be  
26 used if approved by the Contractor.

27  
28 Patch Defective Areas: Repair and patch defective areas with cement mortar immediately  
29 after removal of forms, when approved by the Contractor. Cut out honeycomb, rock pockets,  
30 and voids over 2 in. in any dimension. Thoroughly clean, dampen with water and brush-coat  
31 the area to be patched with specified bonding agent. Place patching mortar after bonding  
32 agent has dried.

33  
34 Defects exceeding 2 in. in diameter shall be repaired by removing defective areas, cleaning,  
35 treating with bonding agent, and replacing with new concrete.

36  
37  
38 FIELD QUALITY CONTROL:

39  
40 Subcontractor Supplied Testing: The Subcontractor shall provide the necessary testing and  
41 monitoring services for the following:

42  
43 Other testing services needed by the Subcontractor to control or monitor the production,  
44 transportation, placement, protection, curing or temperature of the concrete.

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1 The use of Contractor supplied inspection or testing services shall in no way relieve the  
2 Subcontractor of the responsibility to furnish materials and construction in full compliance  
3 with the subcontract documents.

4  
5 Contractor Supplied Testing: The Contractor's Representative may perform tests during  
6 placement and curing of the concrete. Monitoring of concrete protection and curing methods  
7 may also occur.

8  
9 Sampling and testing for quality control during placement of concrete may include the  
10 following:

11  
12 Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with  
13 ASTM C 94.

14 Slump: ASTM C 143.

15 Air Content: ASTM C 231.

16 Concrete Temperature: Test when air temperature is 40 F or below, or when 90° F or  
17 above, and at any other times as selected by the Contractor.

18  
19 Concrete Uniformity Test for Adequacy of Mixing Equipment: ASTM C 94.

20  
21 Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each  
22 compressive strength test, unless otherwise directed.

23  
24 Subsequent tests may include:

25  
26 Compressive Strength Tests: ASTM C 39; frequency of testing shall comply with ACI 318,  
27 Chapter 5, Section 5.6, unless otherwise directed.

28  
29 Strength level of an individual class of concrete shall be considered satisfactory if both of the  
30 following requirements are met:

31  
32 Average of all sets of three (or less if three are not available) consecutive strength tests equal  
33 or exceed the specified 28-day compressive strength.

34  
35 No individual strength test (average of two cylinders) falls below the specified 28-day  
36 compressive strength by more than 500 psi.

37 Inspection or test results not conforming to the stated requirements of this specification shall  
38 be reported to the Operating Contractor's Project Manager for evaluation and disposition with  
39 the concurrence of the Architect/Engineer.

40  
41 Nondestructive Tests: Testing by impact hammer, sonoscope, or other nondestructive device  
42 may be performed to determine relative strengths at various locations in the structure as an  
43 aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests,  
44 unless properly calibrated and correlated with other test data, shall not be used as a basis for  
45 acceptance or rejection of the concrete.

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- 1
- 2 Surveillance will be performed by the Contractor's Representative to verify compliance of the
- 3 work to the drawings and specifications.
- 4
- 5 END OF SECTION 03300